



USE OF AGRICULTURAL LANDS IN UKRAINE: ASSESSMENT OF THE CONSEQUENCES OF THE WAR

Advancing Success Towards SDG2 (Zero Hunger)
Through Science & Technology

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KEY CHALLENGES: EXPLOSIVE DANGEROUS ITEMS

- ▶ **17.4 million hectares** on which hostilities have been or are being fought, territories under temporary occupation, and territories that have been struck are considered to be potentially contaminated with explosives.
- ▶ As of the beginning of 2023, **2.59 million hectares of agricultural land needed surveying**. Additionally, **2.91 million hectares will require survey** after the end of active hostilities.
- ▶ The National Mine Action Authority has approved a plan of measures for the demining of **470.9 thousand hectares** of agricultural land for 2023, which provides for the coordination of actions of state authorities, mine action operators, local self-government bodies and business entities.
- ▶ More than **319,000 explosive objects have already been neutralized by the pyrotechnic units of the State Emergency Service**, and 79,100 hectares have been examined and cleared of explosive objects.

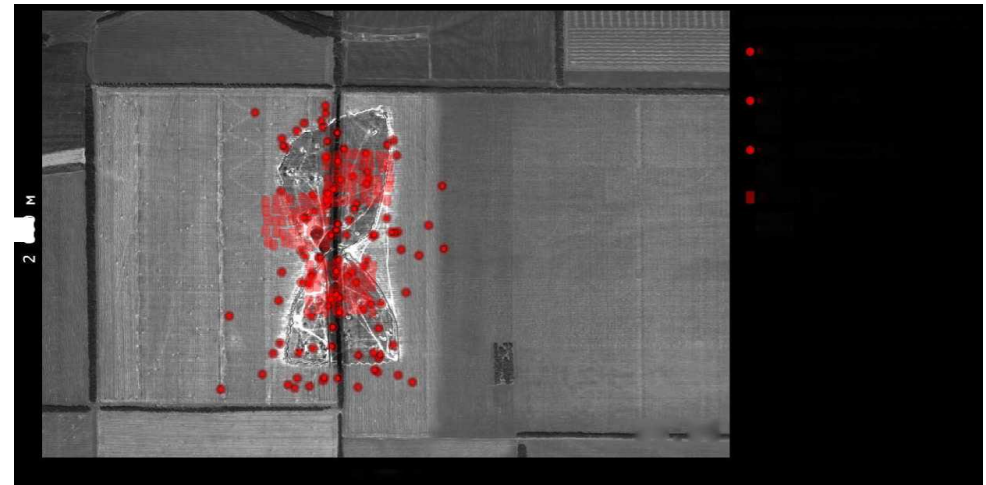


POLLUTION OF THE TERRITORY

- ▶ Russian troops use the "lead wall" tactic, in which **300-350 artillery shots of various calibers are used to destroy one target**, up to 500 shots are used in "difficult" areas. As of August 2022, Russia had spent more than **4 million artillery ammunition**.
- ▶ The Armed Forces of Ukraine solve the task based on the calculation of **10-12 shells** thanks to high-quality intelligence and accuracy of strikes.
- ▶ **6-9% of artillery ammunition does not explode and remains in the soil!**



Околиця м. Бахмут, 2022 р.



Наслідки обстрілу опорного
пункту ЗСУ

POLLUTION OF THE TERRITORY



A shot from a T-72 tank



Phosphorous ammunition, p. Mala Rohan, Kharkiv region



Shell casings at the battle site, Dmytrivka, Kyiv region

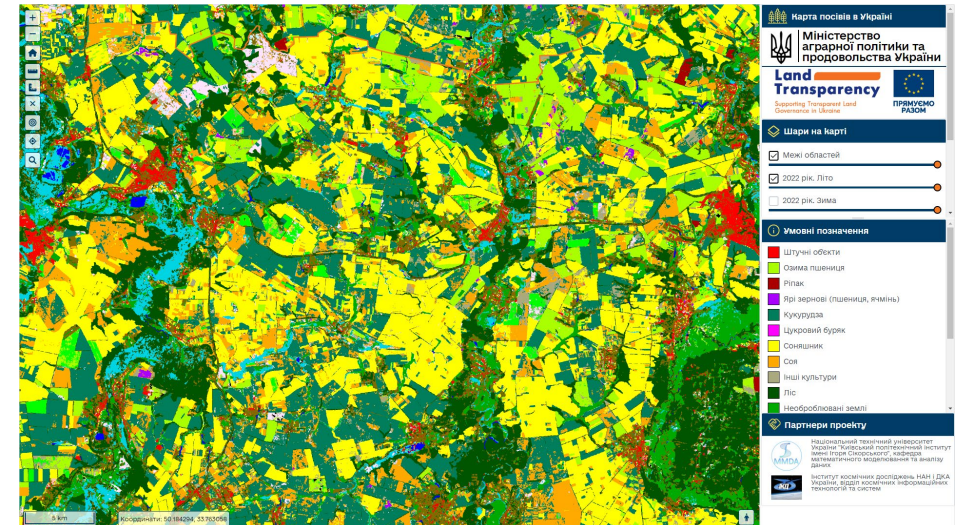
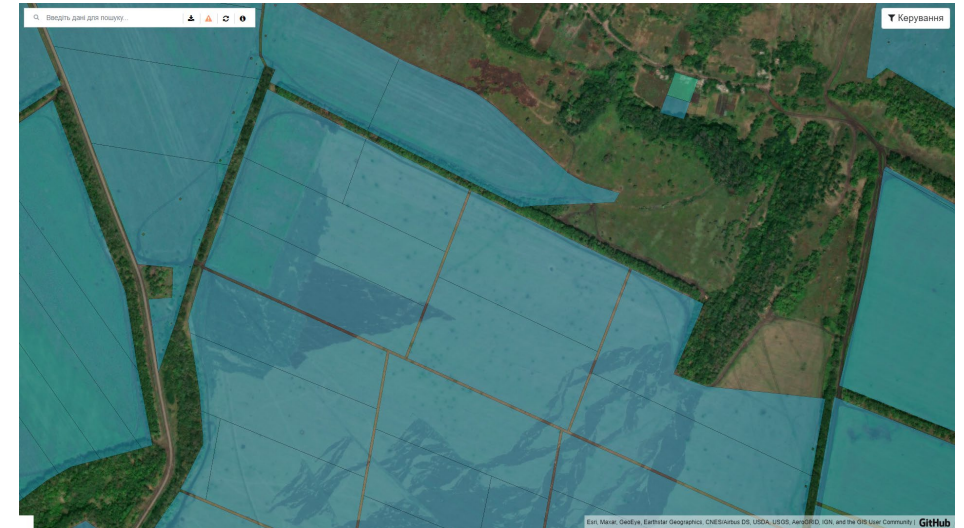


Consequences of rocket fire, Zhytomyr region

- ▶ Most **propellants** are UN GHS hazard class 1.3 composites. Nitrocellulose is one of the least toxic energy materials and is often not considered a major environmental concern, but nitroglycerin and nitroguanidine can leach rapidly into soil and potentially affect groundwater. Ammonium perchlorate is persistent in the environment, readily soluble in water, does not decompose or adsorb, tends to persist for decades, leads to significant soil contamination, adverse health effects at levels above 11 µg/L.
- ▶ **Pyrotechnic devices** include flares, signal flares, colored and white smoke generators, tracer signals, incendiary munitions, etc. Pyrotechnics usually consist of an inorganic oxidizer and metal powder in a binder. Light rockets contain sodium nitrate, magnesium and a binder. Signal flares contain nitrates of barium, strontium or other metals.
- ▶ Significant **metal residues** are deposited during the intended use of munitions and during disposal by incineration, which can cause short-term respiratory distress as well as long-term effects on growth and development in soils and plants. Pyrotechnic devices often use metal salts (eg, barium chromate), which can potentially lead to the deposition of highly toxic metal ions in the environment.
- ▶ The most commonly used **secondary explosive** is nitroaromatic 2,4,6-trinitrotoluene (TNT), which quickly dissolves under the influence of water (200 mg/l) or precipitation. TNT and similar compounds are toxic to humans, animals and plants, at higher concentrations of 2.2 µg/l in drinking water will have a toxic effect. TNT degrades faster in soils with a high content of organic substances. The risks of TNT entering the food chain are higher in the presence of groundwater. Hexogen (RDX) is another common secondary explosive often used in combination with TNT, is much less soluble (30 mg/l), has human toxicity, and an increased risk of cancer.
- ▶ Lead contamination is usually very localized due to the limited mobility of lead in soil (especially clay and loess soils). It is sorbed to organic content and immobilized in soils with low acidity (> pH 5) with an organic content of more than 5%.

LAND AND CADASTRAL ACCOUNTING OF THE DAMAGED TERRITORIES

- ▶ Explosive objects (land mines, ammunition) **make real estate dangerous and unusable**. Contaminated sites remain inaccessible to owners and users until they are inspected and deemed safe.
- ▶ **Paying taxes for immovable property unfit for use, contaminated with explosive objects** (land tax, environmental tax, rent for land plots of state and communal property, minimum tax liability, unified tax of group 4, etc.) **is illogical and unfair**. Before the war, the land fee amounted to UAH 36 billion per year and was the second most important (after personal income tax) source of revenue for local budgets. The amount of such tax benefits can reach UAH 15 billion.
- ▶ The **effective exchange of information between the Information Management System for Mine Action (IMSMA) and the State Land Cadastre** makes it possible to accurately determine the status of contaminated sites and facilitate the application of tax benefits, recognition of force majeure, etc. It is also necessary to cover areas with fortifications and mine-explosive barriers created by the Defense Forces of Ukraine, which also prevent the use of land plots.
- ▶ The implementation of state control over the use and protection of land using the information products of remote sensing of the Earth will allow **to identify land plots used for their intended purpose** and, thus, to **avoid unjustified granting of tax benefits**.



ECONOMICS OF DEMINING: WHAT TO DO WITH CONTAMINATED AREAS?

- ▶ The **cost of demining** varies from **USD 2,000 to 20,000 per hectare**, while traditional mine action technologies make the process **slow and expensive**. The average speed of work of one sapper is 15-40 sq. m per day. The use of a heavy demining machine can, in some cases, increase productivity to 20-40 ha per day.
- ▶ To solve this problem, the government and private organizations must **invest in modernizing and updating the equipment and technologies used in the demining process**. This may include investments in new demining machines and technologies (drones, ground-penetrating radars, robotic systems), as well as training of deminers. The use of special drones can increase the pace of technical inspection up to 3 times.
- ▶ If the **cost of demining, technical and biological stages of reclamation exceeds the market value of the land plot** (for example, for agricultural land it is USD 1,500 per hectare, a possible solution may be to **change the composition of the land and switch to alternative land use options**, including the creation of nature protection territory, forestry, etc.



Heavy demining machine



"Military forests" near Verdun in France - in some areas, the soil is still unable to support the growth of vegetation due to high concentrations of lead (up to 17% of the soil mass). Vegetation is limited only to mosses.